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NAMULONGE, UGANDA

REVIEW OF THE RESEARCH PROGRAMME

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COTTON RESEARCH STATION, NAMULONGE
REVIEW OF THE RESEARCH PROGRAMME

BY

J. B. HUTCHINSON.

A programme for Namulonge was set out in the Progress Report for 1949-50, and the time is now ripe for a review.

The development of the estate has gone very differently from the way planned in 1950. An overriding factor has at all times been the shortage of labour. In the past, a large and steady influx of migrants has provided Buganda with a fairly cheap and fairly plentiful supply of unskilled labour. With the rapid development that has taken place all over East Africa and in neighbouring territories, there has been less inducement to migrate from peripheral areas, and greater competition for the services of those who continue to come in. On the other hand, there is no local source of farm labour such as exists in Western countries. Even town workers live very largely in "peri-urban areas" where wives and families grow on the shamba the greater part of the food supply. In rural areas, the peasant's first preoccupation is with his own shamba, and only to the extent that he can spare the time from it is he willing to work for wages outside. Thus, Namulonge is not only always short of labour. We are shortest at the busy periods of the farming year.

To meet these difficulties the programme of land clearing has been cut down, and arrangements have been made with the Uganda Protectorate Prisons Department for the setting up of a prison labour camp on the farm. It is hoped that we shall now be able to farm intensively the land we have in hand, but further development will be postponed until we can see our way to farming more land effectively.

Crop Husbandry.

The land at present in hand is managed in three farm units and a number of smaller areas devoted specifically to experiments. The object of the farm units is to try out systems of farming in a way that will bring out their practical advantages and defects, to set out the experimental work in such a way that it can be viewed in the context of practical farming, and to provide examples of the problems and rewards involved in the high intensity farming that we feel is bound to come in a developing area such as this.

There are three farms in course of development. Nalumuli is on a 3 year arable/3 year grass system, with units of 25 acres each. Five of these have been broken up. One has gone down to its first ley year, and the second is about to follow. Year 6 is in process of clearing. Associated with this area is a series of paddocks on steep land bordering the swamps, and on stony hillsides near the housing area.

All told the farm will amount to:—

Arable and leys	150 acres.
+10% for grass paths	15
Paddocks approx.	100
	265 acres.

We now have a herd of over 200 head of cattle, plus 60 being looked after for the Makerere farm, and a flock of 92 sheep. Even with only one field under a ley, it has proved impossible to keep all the available grass grazed with the stock at our disposal, and it is clear that, with the impending departure of the Makerere herd, it will be some time before we shall have the stock to graze leys on the other farms on the estate.

Three fields of from 25 to 30 acres each have been cleared and cropped on the Ginnery Farm on the Namulonge-Lukuba section of the estate. It is the intention in due course to clear three more similar fields, to make a second farm on the 3 year arable/3 year grass system.

The third farm is a similar unit, to be known as Sendusu Farm. It will amount to about 50 acres when fully developed. As a contribution to information on the prospects of intensifying crop production, this area will be cropped for six years and rested for three. It is anticipated that the older arable land thus developed will be particularly useful for the Soil Chemist's fertility studies.

Carrying arable production to the limit, there are in all parts of the farmed area small units that will be kept permanently under arable crops. The oldest of these is the Permanent Cultivation Experiment, half of which is under bananas and half under continuous cotton. The fourth cotton crop has now been reaped. Yields have varied widely, but the fluctuations have been related to farming practice and problems of weeds and disease rather than to any considerable decline in fertility. The layout, in $\frac{1}{4}$ acre plots surrounded by grass bounds, favoured invasion by lumbugu (the local couch grass, *Digitaria scalarum*), and the use in the early years of a particularly susceptible cotton variety led to the build up of *Verticillium* wilt. These emphasise the importance of other factors besides loss of intrinsic fertility in determining yield levels in long continued arable cropping.

More recently, a "Communal Experiment", involving plant breeders, plant physiologists, lint physiologist, entomologists, and soil chemist, has been planned to study seasonal fluctuations in yield in a continuous maize/cotton rotation. Three areas of about four acres each have been taken on the oldest arable available in each of the main areas of farmed land. In each area, three annual cropping systems are used: (1) long term maize sown in the first rains and followed by fallow,

(2) green manure ploughed in during the first rains, followed by early planted cotton, and (3) early maize in the first rains followed by cotton rather later planted in the second rains. Crop production will be analysed in terms of climatic factors, insect attack, plant development, and soil factors (moisture and nutrients).

Two other farming areas must be mentioned. On Kigalama approximately 30 acres are devoted to rotation trials, and on the isolated Kirimantungo there are about 30 acres of land where "dangerous" experiments can be laid out. Experiments defined as "dangerous" are those involving cotton varieties widely different from the commercial BP52, and therefore involving a contamination risk, and trials in which disease or pest attack is artificially encouraged.

One of the most striking facts that has emerged in the first four years of farming at Namulonge is the high productive potential of the land. This is well illustrated by the yield figures for the first cropping year on Ginnery Slope, where seven acres gave yields per acre of 2,600 lb. of dry maize, followed by 959 lb. of seed cotton. In fact, with our chronic labour shortage, our problem has been to keep up with the productive capacity of the land, rather than to design an intensive farming system. Our range of farming systems is planned to take advantage of the intrinsic fertility of the land and of the favourable climatic regime, and in this work we are more concerned with avoiding or removing limitations on crop production than with devising means of raising an existing yield ceiling. Among these limiting factors are weeds, especially lumbugu, soil loss by erosion, and the development of an impermeable surface layer preventing the penetration of rainfall. Similarly crop sequence problems are more those of farming convenience and crop timing than of the effect of crop rotations on yield.

It is not our function to do peasant farming rather better and on a larger scale than peasants do, but to explore the farming possibilities of the future. Thus, the problems that will inevitably arise with the intensification of agriculture are under study now. Chief among these are the problems of soil and moisture conservation when large contiguous areas of land are exposed to sun and rain under arable farming. The development of lower (and steeper) slopes than we originally contemplated farming has emphasised the importance of tie ridging (a form of what Engledow has called "self protective husbandry") on the higher and flatter land in order to protect the steeper land below from an uncontrollable flow of water after heavy rain. Similarly, the cultivation of large blocks of a single crop may lead to a change in the incidence of pest attack, and the general experience in Uganda that *Lygus* damage is more severe in large than in small blocks of cotton has made it necessary for us to explore the effect of interspersing cotton with strips of other crops.

Buganda and Busoga on the north shore of Lake Victoria form the biggest cotton producing unit in the Commonwealth outside India, and in this area the provision of power and the development of industry will give rise to an increasing demand for food for the growing towns. From studies of farming systems such as those outlined above will come the knowledge by which production can be raised so that more food can be provided without encroaching on the land now devoted to the cotton crop.

Climatology.

Research in climatology has developed extensively since the first research programme was written. Statistical studies of the rainfall distribution of Buganda have been enlarged to cover the whole of Uganda, and are now being extended southwards over the cotton growing areas of the Lake Province of Tanganyika, and northwards into the southern Sudan. An account of the rainfall regime of the Lake Victoria region is in course of preparation, and in view of the importance of the north equatorial belt for cotton production, it is hoped later to extend the study through the northern Belgian Congo and French Equatorial Africa to Northern Nigeria.

Investigation work centres round the relation between rainfall and soil moisture. Amount, distribution, and rate of rainfall have been under study since the station started. Observations were begun at an early date on run-off and percolation, and an increasingly important body of data is being built up. Techniques of recording soil moisture over a 10 ft. profile have been developed and are under test, and data on open water surface evaporation have been collected on several patterns of evaporimeter. Trial calculations of crop use of water have been made from these data, and more comprehensive work is in progress.

Cotton Physiology.

The physiology programme is closely linked with studies of climate, and of water use in particular. There seems little doubt that some of the major influences governing crop development and fruiting are to be sought in the amount of water available for growth, and its distribution in time and space. Crop histories have been tabulated in each season, and are now recorded annually for early and late sown cotton at each locality in the Communal Experiment. Parallel rainfall and moisture records are collected, and over a period of years it is expected that the climatic patterns governing fluctuations in crop size will be identified.

Lint Physiology.

Since the inception of the station, studies of the physiological factors governing lint quality have been regarded as one of the most important parts of the research programme. With the appointment of a Lint Physiologist in 1951, a start was made. Two lines of attack are being followed. Developmental studies on lint and seed, based on dated boll samples, are yielding information on variation in quality through the cropping season, and on the environmental factors concerned.

The examination of ripe seed cotton has yielded important information on the source of different kinds of nep in yarn, and has led to the development of techniques for estimating proneness to nep that can be used by plant breeders for eliminating undesirable material.

The visit of Mr. C. Underwood of the staff of the Shirley Institute during the 1954 cotton season has been of great value in dividing the testing of plant breeding material between the Shirley Institute and Namulonge, and in the development of testing at the agricultural research station. The establishment of a testing unit to undertake preliminary quality tests for cotton breeders is planned for the near future.

Soil Science.

A Soil Chemist was appointed in 1952. He is concerned with fertility studies, and not with soil survey, and is undertaking a programme of field experiments on the behaviour of plant nutrients in relation to crop development, and to cultural and rotational practices.

The Soil Chemist divides his time between Namulonge in Buganda and Ukiriguru in the Lake Province of Tanganyika. The problems under study at the two stations are fundamentally the same, but the great contrast in climate, crop development and soil conditions makes possible a study of comparative fertility conditions. Such studies not only benefit the two stations, but give promise of demonstrating principles of general application.

Entomology.

Entomological research is likely to be held up owing to a shortage of staff. The emphasis of the programme has changed in the light of recent findings, and much thought is being given to the problem of assessing the actual crop losses consequent on pest attack. This has followed the demonstration of the significance of crop recovery after an attack of *Lygus* has come to an end. On the other hand, these same studies have brought out the importance of a relatively small attack of bollworm for which, since it comes late in the season, compensation

is not possible. Thus, as has so often happened in cotton entomology in the past, the emphasis is increasingly on the response of the plant to pest attack, and rather less on insect studies *per se*.

Plant Pathology.

Outstanding success has been achieved in the past four years in developing rapid and convenient methods of testing for resistance to bacterial blight and *Verticillium* wilt. These have been adopted as routine in plant breeding work, and if a rapid and simple method of assessing resistance to the boll rot phase of bacterial blight can be devised, the provision of techniques for the plant breeder with respect to these two diseases will be complete. Studies of the epidemiology of bacterial blight and *Verticillium* wilt will continue and will be extended to investigate the mode and extent of their survival in the field and the nature of host resistance to them. It is proposed also to undertake a wider survey of the range and relative importance of diseases affecting the cotton boll.

Plant Breeding.

Much of the material originally assembled at Namulonge has been discarded on account of susceptibility to diseases and pests. It soon became evident that nothing could be expected to supersede BP52 locally that was not highly resistant to bacterial blight, and in all other cotton growing areas in East and Central Africa high resistance to jassid is also necessary. Even at Namulonge, a considerable attack of jassid developed in the last season. In planning breeding stocks for the future, therefore, consideration may be confined to combinations that will yield types highly resistant to both jassid and bacterial blight.

The best available stock combining high jassid resistance with the quality required in Buganda is the Barberton bred MU8 × BP52°. High bacterial blight resistance is available in the new Albar 51 series. Hybrids of these two are likely to provide the most important breeding stocks for the future, and they gain an added importance since the Uganda Government has requested the Corporation to undertake cotton breeding work at Serere for the east and north of the Protectorate.

Albar 51 stocks have been sent to a number of other territories for use as bacterial blight resistant parents for crossing purposes. They are not sufficiently jassid resistant for issue on their own account.

For the maintenance and improvement of the current BP52 crop an intensive breeding project is in progress, and an improved stock is now being multiplied.

The most important part of the plant breeding programme is that devoted to the study of breeding technique. That in use in the

improvement of BP52 has attracted attention in many places. It sets out to provide, from the breeding data, an estimate of the rate of advance under selection, and hence a running check on the return obtained for the work done. Such information is of the utmost value where an attempt is to be made to improve a stock already highly bred and fairly uniform.

Less precise methods covering a wider range of material are appropriate for stocks in the early stages of development, such as Albar 51 and its hybrids. An even simpler technique is required when building up a stock from a group of useful parents. This has importance where it is necessary to bring in characters from a number of different stocks, or where it is desired to reassemble a group of polygenes separated in a crossing programme. In either case, crossing in pairs, selecting and crossing again in a systematic synthesis is a long and time consuming business. Since it is not possible in such cases to reduce the number of generations required, the only way of saving time for the breeder is to set up mixed stocks under circumstances favouring natural crossing and to let the process take place naturally while the breeder devotes his attention to material of more immediate importance. Two such stocks have been running for three generations at Namulonge, and consideration is now being given to the types of selection to be applied to favour the multiplication of the desired genotypes.

Problems of breeding technique are of great interest to plant breeders in East Africa. Arising out of discussions with agricultural botanists, a small project has been undertaken with maize which is designed to study the effect of inbreeding, and to form some measure of the relative importance of the elimination of "genetic rubbish" as against hybrid vigour in the success of hybrid maize.

Responsibilities as a Central Station.

Any programme of agricultural research must be based on problems of importance to the area in which it is to be conducted. Namulonge, being situated in the largest of the producing areas it serves, is well placed in this respect. The usefulness of the station to more distant areas depends on a wise choice of problems that are of general significance, and on studies of fundamental principles. That some success has been achieved in our work as a central station is shown by the increasing demand for visits by members of the Namulonge staff, and by the wide range of research correspondence now maintained.

The climatological work is directly applicable to East Africa, as it covers the cotton growing areas of the Lake Victoria region. Elsewhere, the principles involved in assessing crop water supplies and work on

methods of increasing water storage in the soil have aroused much interest and discussion.

An extension of the testing work of the Lint Physiologist to cover all the territories served has been asked for and is now being planned.

In so far as the staff position permits, the entomological programme is linked with the programmes of other entomologists on the Corporation's staff, and exchange of information and data is planned to facilitate a co-ordinated attack on the more important pests.

There is little specialist work on cotton pathology in the contributing territories except at Namulonge, and there is consequently an extensive demand for advice from the Pathologist both by visits and in correspondence.

Plant breeding is essentially a matter for local work, but Namulonge has been able to contribute Albar material for bacterial blight resistance breeding in a wide range of territories, and has taken the lead in much stimulating discussion of breeding methods and problems in East Africa.

Finally, mention should be made of the meetings of the Namulonge Advisory Board, which provide a much valued opportunity for the Namulonge staff to discuss their work with representatives of the contributing territories, to discover what information is required, and to demonstrate that which is now available.

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